

Amendment

Applicant: Michael Paul Tankard

Serial No.: 10/656,821

Filed: September 5, 2003

Docket No.: K315.131.101

Title: CIRCUIT FOR USE WITH SWITCHED RELUCTANCE MACHINES

REMARKS

Claims 1-15 are pending. By this Amendment, claims 1, 12 and 15 are amended.

The December 14, 2004 Office Action rejected claims 1-15 under 35 U.S.C. § 102(b) over Berroth (WO 02/054578) (with U.S. Patent No. 6,825,626 to Berroth being referred to and used as a translation), claims 1-15 under 35 U.S.C. § 102(b) over Labriola (U.S. Patent No. 5,977,737), claims 1-11 under 35 U.S.C. § 102(b) over Ferreira (U.S. Patent No. 6,028,760), and claims 12-15 under 35 U.S.C. § 103(a) over Ferreira. Applicant respectfully traverses these rejections.

Independent Claims 1, 12 and 15**Berroth**

Independent claim 1, lines 5-6, recite that the switches of the first set are rated for a higher current than the switches of the second set. Claim 12, lines 9-10 and claim 15, lines 8-9, recite similar features. Berroth, on the other hand, does not disclose a first set of switches (indicated in the Office Action as 114, 136) rated higher than the remaining two switches forming a second set (indicated in the Office Action as 130, 132). Accordingly, independent claims 1, 12, and 15 are not anticipated by Berroth.

Additionally, it would not have been obvious to modify Berroth to include these features, as doing so would impair the operability and efficiency of Berroth. The circuit of Berroth would be highly wasteful if differently rated switches were to be used; Berroth therefore teaches away from the present invention.

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More specifically, Berroth relates to a controller for an electronically commutated motor or brushless DC machine. In a brushless DC machine, instead of an AC voltage source, an alternating voltage is applied to the phase winding using a DC voltage source and an H-Bridge connection. The resulting current through the winding can be seen from Figure 3 of Berroth in conjunction with column 5, lines 40-46. During a first half of Berroth's phase cycle, a current i_1 flows through the winding when transistors 114 and 136 are switched on, connecting the left terminal 104 of the winding 102 to the supply voltage the right terminal 106 to ground. During the second half of the phase cycle, transistors 130 and 132 are conductive, connecting the left terminal 104 to ground and the right terminal 106 to the supply voltage, such that a negative current i_2 flows in the winding. Thus, during a phase cycle, both sets of switches connect the winding to the supply voltage and ground and thus conduct substantially the *same* peak currents. Therefore, if one or more of the switches were rated to a higher current, the current that could safely be sustained would be limited by the lower rated switches, such that the higher rating of the other switches would be wasted. Accordingly, Berroth teaches directly away from switches of a first set being rated for a higher current than switches of a second set, as recited in independent claims 1, 12 and 15.

Labriola

Regarding Labriola, essentially the same argument applies. Figure 1 and column 1, lines 43-90 of Labriola describe an H-Bridge connection analogous to the one described in Berroth. In addition, Figure 5 shows a switching pattern of switches Q1 to Q4 of one phase cycle connecting the left terminal of the winding to the voltage supply and the right terminal to ground during a

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first half of the phase cycle, and vice versa during the second half of the phase cycle. All switches conduct substantially the same peak currents. Labriola thus teaches away from switches of a first set being rated for a higher current than switches of a second set, as recited in claims 1, 12 and 15.

Ferreira

Ferreira describes a pulse generator using bipolar current pulses. A positive current flows through the coil when switches Q1 and Q3 are conducting, and a negative current flows through the coil when switches Q4 and Q2 are conducting, as described in column 5, line 56 - column 6, line 46. As the current through the inductance is symmetric about zero in successive halves of the phase cycle, switches Q1 and Q3 and Q2 and Q4 carry the same (positive and negative, respectively) current. Far from there being a teaching of sets of switches being rated differently, as claimed, such an arrangement would be non-sensical in the context of the disclosure of Ferreira. Ferreira thus also teaches away from the claimed invention.

Conclusion

In short, there is nothing in Berroth, Labriola or Ferreira that anticipates or renders obvious claims 1, 12 and 15. Because using sets of switches with different ratings would not make sense in the context of any of these prior-art references, there is nothing that would motivate the skilled person to arrive at the claimed invention. In fact, as referenced above, the cited documents teach away from the invention, because the provision of differently rated sets of switches would be uneconomical and of no benefit.

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Independent Claim 14

Regarding independent method claim 14, neither Berroth nor Labriola disclose a motoring mode, during which current through the recited phase winding is supplied via the first set and returned to the supply via the second set, nor a generating mode, supplying current to the phase winding via the second set and returning current to the supply via the first set. See e.g. independent claim 14, lines 6-9. Moreover, there is no disclosure of both supplying from the supply and returning current to the supply during a given mode of operation (motoring or generating), as claimed.

More specifically, neither Berroth nor Labriola relate to a generating mode. Figure 3 of Berroth shows a single phase cycle of a motoring mode, the negative current through the winding after point 222 being due to operation of the H-Bridge. Labriola, at column 11, line 28 – column 12, line 8 (referenced by the Office Action with respect to claim 3, on page 5 of the Office Action) relates to the problem of crossover, when the current through the winding crosses zero as the H-Bridge is switched. This occurs during each phase cycle. Neither Berroth nor Labriola disclose the claimed generating mode, and neither disclose the claimed motoring mode during which current through the phase winding is supplied via the first set and returned to the supply via the second set.

Ferreira relates to a pulse generator. Ferreira contains no teaching of a motoring mode or a generating mode, as it is not related to rotary machines. Consequently, Ferreira cannot teach reversing the direction of current between a motoring and a generating mode, as recited in claim 14. Figures 3-4 show successive positive and negative pulses of current, but there is no teaching of reversing a current direction in the winding from one operating mode to another. It should

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also be noted that the direction of current through switches Q1-Q4 of Ferreira is always the same, the current being discharged from the winding not through the switches, but through the corresponding diodes. Thus, there is no reversal of current direction through the switches. Since Ferreira bears no relation to motoring or generating applications, one of ordinary skill in the art would not have been motivated to devise a method as recited in claim 14.

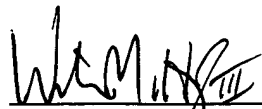
Conclusion

In view of the foregoing, Applicant submits that this application is in condition for allowance. Favorable reconsideration and prompt allowance are requested. The Commissioner is hereby authorized to grant any extensions of time and to charge any fees under 37 C.F.R. § 1.16 and § 1.17 that may be required during the entire pendency of this application, or to credit any overpayment, to Deposit Account No. 500471.

The Examiner is invited to telephone the undersigned to advance prosecution.

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Respectfully submitted,

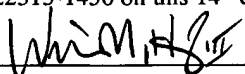


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Please grant any extension of time necessary for entry; charge any fee due to Deposit Account No. 500471.

CERTIFICATE UNDER 37 C.F.R. 1.8:

The undersigned hereby certifies that this paper or papers, as described herein, are being deposited in the United States Postal Service, as first class mail with sufficient postage, in an envelope addressed to Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 14th day of March 2005.

By 
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